Hope Basin Play 1: Late Sequence (Oligocene-Pliocene)

Correlative to Chukchi Sea Play 26

Geological Assessment

GRASP UAI: AAAAA FAB
Play Area: 18,201 square miles
Play Water Depth Range: 50-180 feet
Play Depth Range: 1,000-8,000 feet
Play Exploration Chance: 0.0768

Play 1, Late Sequence (Oligocene-Pliocene), Hope Basin OCS Planning Area, 2006 Assessment, Undiscovered Technically-Recoverable Oil & Gas			
Assessment Results as of November 2005			
Resource Commodity (Units)	Resources *		
	F95	Mean	F05
BOE (Mmboe)	0	457	1,762
Total Gas (Tcfg)	0.000	2.074	7.990
Total Liquids (Mmbo)	0	88	340
Free Gas** (Tcfg)	0.000	2.047	7.884
Solution Gas (Tcfg)	0.000	0.027	0.106
Oil (Mmbo)	0	37	142
Condensate (Mmbc)	0	51	198

** Risked, Technically-Recoverable*

*** Free Gas Includes Gas Cap and Non-Associated Gas*

F95 = 95% chance that resources will equal or exceed the given quantity

F05 = 5% chance that resources will equal or exceed the given quantity

BOE = total hydrocarbon energy, expressed in barrels-of-oil-equivalent, where 1 barrel of oil = 5,620 cubic feet of natural gas

Mmb = millions of barrels

Tcf = trillions of cubic feet

Table 1

Play 1, the "Late Sequence" play, is the dominant play in the Hope Basin OCS Planning Area, with 56% (457 Mmboe) of the Planning Area energy endowment (821 Mmboe). The overall assessment results for play 1 are shown in table 1. Oil and gas-condensate liquids form 19% of the hydrocarbon energy endowment of play 1. Table 5 reports the detailed assessment results by commodity for play 1.

Table 3 summarizes the volumetric input data developed for the *GRASP* computer model of Hope basin play 1. Table 4 reports the risk model used for play 1. The location of play 1 is shown in figure 1.

Play 1 includes all Oligocene(?) and younger strata in the assessment area. Shallow shelf or fluvial-deltaic sandstones form the most likely reservoir rocks. Two exploratory wells drilled in Kotzebue basin indicate that the sandstones in the Late Sequence play are highly porous. Organic material in Kotzebue basin well samples is cellulosic (woody) with hydrogen indices generally below 200 mgHC[1]/gTOC[2], indicating that any hydrocarbons generated upon burial and heating would probably be gas. Total organic carbon values average over 1.0 percent, but higher values are associated with coals[3] and confined to the upper, thermally immature part of the sequence. The coals may form sources for biogenic (bacterial) gas. Only very small volumes of this sequence, in the very deepest parts of the basins, achieve thermal maturity appropriate for thermogenic creation of petroleum. Therefore, hydrocarbons would have to migrate into Late Sequence prospects from thermally mature sources among older Tertiary

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[1] ***HC**, hydrocarbon matter evolved from samples during heating (pyrolysis) experiments.*

[2] ***TOC**, total organic carbon*

[3] *therefore not indicative of any significant petroleum source potential*

(Eocene) rocks near the floor of the basin in the area where these rocks reach depths greater than 7,300 ft subsea (corresponds to 0.6% Ro isograd). Traps within the Late Sequence play were formed during a second stage of widespread basin faulting, probably in Miocene(?) time, well before the deepest sediments in the basins reached thermal maturity, the latter probably occurring in Pliocene or Pleistocene time. Outside of the thermally-mature area, prospects must be charged primarily by biogenic methane. Rocks correlative to play 01 were penetrated by the Cape Espenberg and Nimiuk Point wells in Kotzebure Sound.

Play 1, Late Sequence, Hope Basin OCS Planning Area, 2006 Assessment, Conditional BOE Sizes of Ten Largest Pools

Assessment Results as of November 2005

Pool Rank	BOE Resources *		
	F95	Mean	F05
1	110	355	958
2	74	186	359
3	54	132	248
4	40	102	188
5	30	82	152
6	23	67	127
7	17	56	107
8	13	47	92
9	10	40	81
10	8	35	71

** Conditional, Technically-Recoverable, Millions of Barrels Energy-Equivalent (Mmboe), from "PSRK.out" file*

F95 = 95% chance that resources will equal or exceed the given quantity

F05 = 5% chance that resources will equal or exceed the given quantity

BOE = total hydrocarbon energy, expressed in barrels-of-oil-equivalent, where 1 barrel of oil = 5,620 cubic feet of natural gas

Table 2

A maximum of 42 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 1. These 42 pools range in mean conditional (un-risked) recoverable volumes from 5 Mmboe (pool rank 42) to 355 Mmboe (pool rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 110 Mmboe (F95) to 958 Mmboe (F05), or in a gas case from 0.62 Tcfge (F95) to 5.38 Tcfge (F05). Table 2 shows the conditional sizes of the 10 largest pools in play 1.

In the computer simulation for play 1 a total of 55,946 “simulation pools” were sampled for size. These simulation pools can be grouped according to the USGS size class system in which sizes double with each successive class. Pool size class 11 contains the largest share (14,277, or 26%) of simulation pools (conditional, technically recoverable BOE resources) for play 1. Pool size class 11 ranges from 32 to 64 Mmboe. The largest simulation pool for play 1 falls within pool size class 17, which ranges in size from 2,048 to 4,096 Mmboe (or 12 to 23 Tcfge). Table 6 reports statistics for the simulation pools developed in the GRASP computer model for play 1.

GRASP Play Data Form (Minerals Management Service-Alaska Regional Office)

Basin: Hope Basin Planning Area
Play Number: 01
Play UAI Number: AAAAA FAB

Assessor: K.W. Sherwood
Play Name: Late Sequence (Oligocene-Pliocene)

Date: January 2005

Play Area: mi² (million acres) 18,201 (11.650)
Reservoir Thermal Maturity: % Ro 0.20 - 0.60

Play Depth Range: feet 1,000 - 8,000 (mean = 5,000)
Expected Oil Gravity: ° API 40
Play Water Depth Range: feet 50 - 180 (mean = 150)

POOLS Module (Volumes of Pools, Acre-Feet)

Fractile	F100	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Prospect Area (acres)-Model Input*	2760		3992		10832	14670/13399			29389				77090
Prospect Area (acres)-Model Output**	2763	3754	4587	6986	11257	14606/11157	18475	24178	29199	37271			76925
Fill Fraction (Fraction of Area Filled)	0.05	0.09	0.10	0.12	0.15	0.16/0.05	0.18	0.21	0.22	0.25			0.50
Productive Area of Pool (acres)***	191	502	627	997	1692	2292/1955	2923	3841	4660	6211	7900	9100	22149
Pay Thickness (feet)	10	62	74	100	145	160/85	200	230	260	320	390	440	600

* model fit to prospect area data in *BESTFIT*
** output from *@RISK* after aggregation with fill fraction
*** from *@RISK* aggregation of probability distributions for prospect area and fill fraction

MPRO Module (Numbers of Pools)

Input Play Level Chance	0.4
Output Play Level Chance*	0.3999

* First Occurrence of Non Zero Pools As Reported in PSUM Module

Prospect Level Chance	0.192

Exploration Chance	0.0768

Risk Model	Play Chance	Petroleum System Factors	Prospect Chance
		Seal Integrity (sandy, shallow, faulted sequence)	0.6
		Reservoir Presence (mostly sag-phase mudrocks?)	0.8
	0.5	Source Presence (unknown)	
	0.8	Source Maturity (generative volume limited to very small part of basin)	
		Migration (mostly vertical up faults; risk of diversion to surface and no access for much of basin away from generation area)	0.4

Fractile	F99	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Numbers of Prospects in Play	47	53	57	63	71	72.82/13.38	80	85	90	95	100	110	141
Numbers of Pools in Play						5.59/7.35	12	15	17	19	21	23	42

Zero Pools at F40.00

Minimum Number of Pools	9 (F35)

Mean Number of Pools	5.59

Maximum Number of Pools	42

POOLS/PSRK/PSUM Modules (Play Resources)

Fractile	F100	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Oil Recovery Factor (bbl/acre-foot)	37	131	162	229	325	353/168	446	519	576	665	740	800	1320
Gas Recovery Factor (Mcfg/acre-foot)	159	461	564	741	986	1029/390	1272	1427	1550	1730	1800	1900	2779
Gas Oil Ratio (Sol'n Gas)(cf/bbl)	400	610	640	690	750	748/99	810	845	865	900	930	955	1100
Condensate Yield ((bbl/Mmcfg)	13	18	19	22	25	25/5	28	30	31	33	36	38	50

Pool Size Distribution Statistics from *POOLS* (1,000 BOE): μ (mu)= 10.776 σ^2 (sigma squared)= 1.137

Random Number Generator Seed= 039012

BOE Conversion Factor (cf/bbl)	5620
Probability Any Pool is 100% Oil	0
Probability Any Pool is 100% Gas	0.9

Probability Any Pool Contains Both Oil and Free Gas (Gas Cap)	0.1
Fraction of Pool Volume Gas-Bearing in Oil Pools with Gas Cap	0.5

Table 3. Input data for Hope basin play 1, 2006 assessment.

Risk Analysis Form - 2006 National Assessment

Assessment Province:	Hope Basin OCS Planning Area	**Play Number, Name:**	1. Late Sequence (Oligocene-Pliocene)
Assessor(s):	Kirk W. Sherwood	**Play UAI:**	AAAAA FAB
Date:	1-Jan-05		

For each component, a *quantitative* probability of success (i.e., between zero and one, where zero indicates no confidence and one indicates absolute certainty) based on consideration of the *qualitative* assessment of **ALL** elements within the component was assigned. This is the assessment of the probability that the minimum geologic parameter assumptions have been met or exceeded.

			Play Chance Factors	Averge Conditional Prospect Chance[1]
1.	**Hydrocarbon Fill component** (1a * 1b * 1c)	**1**	***0.4000***	***0.4000***
	a. Presence of a Quality, Effective, Mature Source Rock			
	Probability of efficient source rock in terms of the existence of sufficient volume of mature source rock of adequate quality located in the drainage area of the reservoirs.	1a	0.40	1.00
	b. Effective Expulsion and Migration			
	Probability of effective expulsion and migration of hydrocarbons from the source rock to the reservoirs.	1b	1.00	0.40
	c. Preservation			
	Probability of effective retention of hydrocarbons in the prospects after accumulation.	1c	1.00	1.00
2.	**Reservoir component** (2a * 2b)	**2**	***1.0000***	***0.8000***
	a. Presence of reservoir facies			
	Probability of presence of reservoir facies with a minimum net thickness and net/gross ratio (as specified in the resource assessment).	2a	1.00	0.80
	b. Reservoir quality			
	Probability of effectiveness of the reservoir, with respect to minimum effective porosity, and permeability (as specified in the resource assessment).	2b	1.00	1.00
3.	**Trap component** (3a * 3b)	**3**	***1.0000***	***0.6000***
	a. Presence of trap			
	Probability of presence of the trap with a minimum rock volume (as specified in the resource assessment).	3a	1.00	1.00
	b. Effective seal mechanism			
	Probability of effective seal mechanism for the trap.	3b	1.00	0.60
	Overall Play Chance (Marginal Probability of hydrocarbons, MPhc)		***0.4000***	
	(1 * 2 * 3) *Product of All Subjective Play Chance Factors*			
	Average Conditional Prospect Chance[1]			***0.1920***
	(1 * 2 * 3) *Product of All Subjective Conditional Prospect Chance Factors*			
	[1] Assumes that the Play exists (where all play chance factors = 1.0)			
	Must be consistent with play chance and prospect distribution -- See discussion on Page 3 of Guide			
	Exploration Chance		***0.0768***	
	(Product of Overall Play Chance and Average Conditional Prospect Chance)			

Comments: *See guidance document for explanation of the Risk Analysis Form*

1a: 0.5 source presence; 0.8 source maturation; combined = 0.4

Table 4. Risk model for Hope basin play 1, 2006 assessment.

GRASP - Geologic and Economic Resource Assessment Model - PSUM Module Results

Minerals Management Service - Alaska OCS Region

GRASP Model Version: 8.29.2005)

Computes the Geologic Resource Potential of the Play

Play UAI:	**AAAAAFAB**		**Play No.**		**1**		
World	Level	-	World	Level		Resources	
Country	Level	-	UNITED	STATES		OF	AMERICA
Region	Level	-	MMS	-		ALASKA	REGION
Basin	Level	-	**HOPE**	**BASIN**			
Play	**Level**	**-**	**Play**		**1**	**Late Sequence (Oligocene-Pliocene)**	
Geologist	Kirk	Sherwood					
Remarks	2005	Assessmnent					
Run Date & Time:		Date	19-Sep-05	Time		14:04:23	

Summary of Play Potential

Product	MEAN	Standard Deviation
BOE (Mboe)	457,140	655,280
Oil (Mbo)	36,609	93,199
Condensate (Mbc)	51,430	74,177
Free (Gas Cap & Nonassociated) Gas (Mmcfg)	2,047,100	2,942,100
Solution Gas (Mmcfg)	27,290	69,302

10000 (Number of Trials in Sample)

0.3999 (MPhc [Probability] of First Occurrence of Non-Zero Resource)

Windowing Feature: used

Empirical Probability Distributions of the Products

Greater Than Percentage	BOE (Mboe)	Oil (Mbo)	Condensate (Mbc)	Free (Gas Cap & Nonassociated) Gas (Mmcfg)	Solution Gas (Mmcfg)
100	0	0	0	0	0
99.99	0	0	0	0	0
99	0	0	0	0	0
95	0	0	0	0	0
90	0	0	0	0	0
85	0	0	0	0	0
80	0	0	0	0	0
75	0	0	0	0	0
70	0	0	0	0	0
65	0	0	0	0	0
60	0	0	0	0	0
55	0	0	0	0	0
50	0	0	0	0	0
45	0	0	0	0	0
40	111,260	4,858	12,818	522,240	3,728
35	597,290	31,171	69,079	2,770,200	23,241
30	761,840	56,134	86,140	3,440,000	41,971
25	909,810	60,905	103,310	4,145,900	44,340
20	1,049,400	71,080	119,830	4,771,300	53,421
15	1,212,900	126,020	133,780	5,263,900	92,593
10	1,423,100	128,810	159,220	6,282,100	97,195
8	1,533,400	133,280	170,970	6,807,700	100,150
6	1,673,800	161,750	185,350	7,333,200	122,680
5	1,762,000	142,480	197,720	7,884,300	105,940
4	1,854,500	154,310	208,330	8,269,600	114,470
2	2,160,200	193,310	238,360	9,572,000	142,130
1	2,452,800	211,450	271,820	10,913,000	155,780
0.1	3,279,500	371,310	347,290	14,083,000	309,220
0.01	4,977,700	469,470	572,390	21,808,000	311,700
0.001	5,056,700	107,680	595,680	24,380,000	86,008

Table 5. Assessment results by commodity for Hope basin play 1, 2006 assessment.

Basin: HOPE BASIN
Play 01 - Late Tertiary Sequence
UAI Key: AAAAAFAB

Model Simulation "Pools" Reported by "Fieldsize.out" *GRASP* Module

Classification and Size				Pool Count Statistics				Pool Types Count			Mixed Pool Range		Oil Pool Range		Gas Pool Range		Total Pool Range			Pool Resource Statistics (MMBOE)			
Class	Min (MMBOE)	Max (MMBOE)	Pool Count	Percentage	Trial Average	Trials w/Pool Avg		Mixed Pool	Oil Pool	Gas Pool	Min	Max	Min	Max	Min	Max	Min	Max		Min	Max	Total Resource	Average Resource
1	0.0312	0.0625	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
2	0.0625	0.125	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
3	0.125	0.25	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
4	0.25	0.5	7	0.012512	0.0007	0.00175		0	0	7	0	0	0	0	1	1	1	1		0.399103	0.453401	2.941506	420.215130
5	0.5	1	21	0.037536	0.0021	0.00525		1	0	20	1	1	0	0	1	2	1	2		0.572575	0.981693	16.626280	791.727602
6	1	2	153	0.273478	0.0153	0.03825		7	0	146	1	1	0	0	1	1	1	1		1.036695	1.997143	243.859170	1.593851
7	2	4	599	1.070675	0.0599	0.14975		18	0	581	1	1	0	0	1	3	1	3		2.002022	3.999931	1890.751000	3.156513
8	4	8	2029	3.626711	0.2029	0.50725		99	0	1930	1	2	0	0	1	4	1	4		4.000583	7.996249	12330.282000	6.077024
9	8	16	5581	9.975691	0.5581	1.39525		345	0	5236	1	3	0	0	1	7	1	7		8.004452	15.998589	67488.696000	12.092581
10	16	32	10826	19.350803	1.0826	2.7065		777	0	10049	1	3	0	0	1	11	1	11		16.001415	31.996732	257328.252000	23.769466
11	32	64	14277	25.519251	1.4277	3.56925		1304	0	12973	1	4	0	0	1	13	1	15		32.003370	63.997952	658166.200000	46.099754
12	64	128	12584	22.493118	1.2584	3.146		1415	0	11169	1	4	0	0	1	14	1	15		64.004498	127.990159	1136020.000000	90.274948
13	128	256	7059	12.617524	0.7059	1.76475		1051	0	6008	1	3	0	0	1	8	1	9		128.001028	255.919369	1238702.000000	175.478409
14	256	512	2216	3.960962	0.2216	0.554		393	0	1823	1	3	0	0	1	5	1	5		256.041733	510.974410	754834.968000	340.629486
15	512	1024	524	0.936617	0.0524	0.131		108	0	416	1	2	0	0	1	3	1	3		512.700315	1017.926000	350892.493000	669.642151
16	1024	2048	69	0.123333	0.0069	0.01725		18	0	51	1	1	0	0	1	1	1	1		1043.196000	2040.052000	90927.722000	1.317793
17	2048	4096	1	0.001787	0.0001	0.00025		0	0	1	0	0	0	0	1	1	1	1		2598.200000	2598.200000	2598.200000	2.598199
18	4096	8192	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
19	8192	16384	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
20	16384	32768	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
21	32768	65536	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
22	65536	131072	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
23	131072	262144	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
24	262144	524288	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
25	524288	1048576	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
Not Classified			0	0	0	0	Below Class	0	0	0									Below Class	0.000000	0.000000	0.000000	0.000000
		Totals	**55946**	**100**	**5.5946**	**13.9865**	Above Class	0	0	0									Above Class	0.000000	0.000000	0.000000	0.000000

Number of Pools not Classified: 0
Number of Pools below Class 1: 0
Number of Trials with Pools: 4000

Min and Max refer to numbers of pools of the relevant size class that occur within any single trial in the simulation.

Min and Max refer to aggregate resources of the relevant size class that occur within any single trial in the simulation.

Table 6. Statistics for simulation pools created in computer sampling run for Hope basin play 1, 2006 assessment.

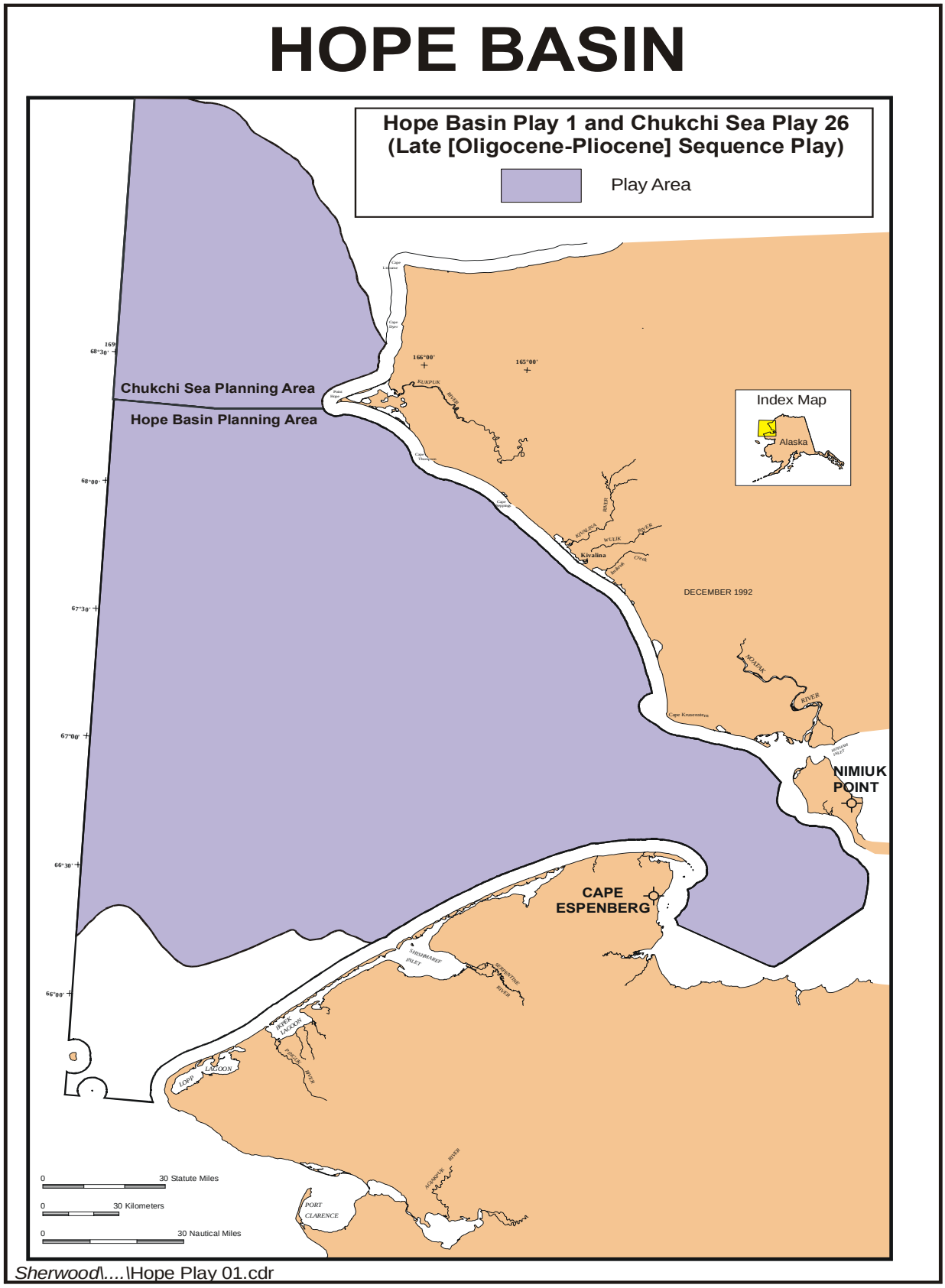

Figure 1. Map location of Hope basin play 1, 2006 assessment.